PACS could enhance medical education by providing sophisticated retrieval capability from the image database based on radiologic or pathologic findings.

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Shoulder Magnetic Resonance Imaging

THE STRENGTH AND STABILITY of the most mobile but least stable joint in the body, the glenohumeral joint, is provided by the four muscles of the rotator cuff. The supraspinatus, infraspinatus, teres minor, and subscapularis muscles form a musculotendinous cuff that envelopes the humeral head and glenohumeral joint. The supraspinatus muscle is interposed between the humeral head and coracoacromial arch.

The impingement syndrome is a common cause of shoulder pain and may cause 95% of rotator cuff tears. When the soft tissue structures of the rotator cuff become entrapped between the coracoacromial arch and the greater tuberosity of the proximal humerus during abduction and elevation of the arm, a series of pathologic events may occur. Subacromial bursitis and rotator cuff tendinitis occur first with progression to fibrosis and rupture of the rotator cuff later. The impingement may occur at the site of the anterior acromion, at the acromioclavicular joint due to spurring, or along the undersurface of the coracoacromial ligament.

Most rotator cuff tears affect the supraspinatus tendon 1 cm proximal to its site of insertion, the "critical zone," near its attachment to the humeral tuberosity. Anterior and posterior extensions may occur, but less frequently. Complete tears are defined as full thickness tears of the rotator cuff. Partial tears are incomplete tears that do not allow fluid to flow between the glenohumeral joint and the subacromial bursa.

The signs and symptoms of rotator cuff tears are not specific. Consequently, the diagnosis is often delayed until a complete tear has occurred. The goal of evaluating shoulder pain should be to determine the cause before irreversible tendon damage has occurred.

Magnetic resonance imaging (MRI) provides excellent depiction of the anatomic structures of the shoulder, including the rotator cuff, the long head of the biceps tendon, articular capsule, muscles, and bone. The improved contrast and additional imaging planes of MRI provide the orthopedic surgeon with anatomic information regarding the presence of tendinitis versus a partial tear versus a complete tear of the rotator cuff. This information, in addition to the clinical presentation, assists the surgeon in determining treatment, that is, physical therapy, arthroscopy, or an open surgical procedure.

The MRI findings of tendinitis are thickening of the cuff tendon and intermediate (grey) signal replacing the normal low signal (black) tendon. Partial tears show a focal thinning of the tendon and may have fluid within the niche. With complete rotator cuff tears, the normal low-intensity signal of the tendons is interrupted by a bright signal indicating discontinuity of the rotator cuff. The (high signal) discontinuity may be filled by either fluid, granulation tissue, or hypertrophied synovium.

Compared with arthroscopy, MRI showed a sensitivity of 100% and specificity of 88% in evaluating rotator cuff tears and a sensitivity of 92% and a specificity of 100% compared to a surgical procedure. Magnetic resonance imaging is able to show bony impingement on the rotator cuff tendon and can indicate other causes of shoulder pain, including effusions, occult fractures, metastases, avascular necrosis, labral tears, and loose bodies. Magnetic resonance gadolinium arthrography may be indicated in cases of dynamic instability, failed surgical procedures for rotator cuff tears, negative noncontrast MRI, and in differentiating partial tears from tendinitis.

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The Imaging of Impotence

IMPOTENCE AFFECTS more than 10 million men in the United States. Clinical evaluation usually can exclude endocrinologic imbalance, neurogenic dysfunction, and psychologic problems as etiology. A patient who fails to get an erection after vasoactive medications are injected probably has hemodynamic impotence. Dynamic studies that include imaging techniques are now available to discriminate between arterial and venous pathology.

Doppler ultrasound with color flow and spectral analysis, dynamic infusion corpus cavernosometry and cavernosography, and selective internal pudendal arteriography are outpatient diagnostic procedures that will differentiate, image, and quantify the abnormalities in patients with hemodynamic impotence. Not all tests are needed in every patient. Each of these examinations is preceded with the intracavernosal injection of vasoactive medication. Papaverine hydrochloride, phentolamine mesylate, or prostaglandin E_1 will overcome normal sympathetic tone and produce an erection by smooth muscle relaxation and arterial dilatation in a normal patient.

Color-flow Doppler and spectral analysis will show the cavernosal arteries and can identify the hemodynamic effects of stricture or occlusion. Peak systolic velocity is measured. Normal ranges are well established. Spectral analysis also is used to predict the presence of venous disease. Sizable venous leaks in the dorsal penile vein are readily imaged. While the technique may not adequately identify low-grade venous pathology, it will identify the size and location of fibrous plaque formation associated with Peyronie's disease.

Cavernosography or cavernosometry is a separate procedure that will quantitate the severity of venous incompetence as well as specifically identify the various avenues of systemic venous return that must be localized if venous occlusive therapy is chosen. In this study, the peak arterial systolic occlusion pressure is quantified during erection, and the presence of arterial pathology can be confirmed. The arterial data are not as reliable as the ultrasound-obtained data because they rely on audible Doppler, which can be obscured in the underlying "noise" heard with erection. The arterial data obtained with both of these examinations are quantitative and replace the qualitative audible Doppler used previously. Specialized equipment (Life Tech, Houston, Texas) allows dy-